IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
TYLER DIVISION

IVAN G. RICE	§	
	§	
Plaintiff	§	
	§	**CIVIL ACTION NO. 6:05cv330**
vs.	§	
	§	
HONEYWELL INTERNATIONAL, INC. and ROLLS-ROYCE, PLC.,	§	
	§	
	§	
Defendants,	§	
	§	
vs.	§	
	§	
NORTHROP GRUMMAN CORP.,	§	
	§	
Third-Party Defendant	§	

MEMORANDUM OPINION AND ORDER

This claim construction opinion construes terms in U.S. Patent No. 4,896,499 and in Reexamined U.S. Patent No. B1 4,896,499 (collectively referred to as "the '499 patent"). Plaintiff Ivan G. Rice ("Rice") asserts that Defendants Honeywell International, Inc.[1] and Rolls-Royce PLC ("Rolls-Royce") have infringed Claim 1 of the '499 patent.

The Patent

The '499 Patent is entitled "Compression Intercooled Gas Turbine Combined Cycle" and is directed to a power system having a "twin spool" gas generator and a power turbine. The gas generator has a low pressure turbine and a high pressure turbine with coaxial shafting to drive a low pressure compressor and a high pressure compressor. An external intercooler is positioned between the low pressure compressor and the high pressure compressor to boost efficiency. The intercooler

[1] Rice's claims against Honeywell were dismissed on July 10, 2006. (Doc. No. 87)

cools air flow using a counter-flow coolant. The cooled air that is introduced to the inlet of the high pressure compressor has a greater density than the air compressed by the low pressure compressor. As a consequence of the greater density of the air, the flow area of the low pressure compressor is increased in proportion to the decrease in the absolute temperature.

Applicable Law

"It is a 'bedrock principle' of patent law that 'the claims of a patent define the invention to which the patentee is entitled the right to exclude." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc) (quoting *Innova/Pure Water Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1115 (Fed. Cir. 2004)). In claim construction, courts examine the patent's intrinsic evidence to define the patented invention's scope. *See id.*; *C.R. Bard, Inc. v. U.S. Surgical Corp.*, 388 F.3d 858, 861 (Fed. Cir. 2004); *Bell Atl. Network Servs., Inc. v. Covad Communications Group, Inc.*, 262 F.3d 1258, 1267 (Fed. Cir. 2001). This intrinsic evidence includes the claims themselves, the specification, and the prosecution history. *See Phillips*, 415 F.3d at 1314; *C.R. Bard, Inc.*, 388 F.3d at 861. Courts give claim terms their ordinary and accustomed meaning as understood by one of ordinary skill in the art at the time of the invention in the context of the entire patent. *Phillips*, 415 F.3d at 1312-13; *Alloc, Inc. v. Int'l Trade Comm'n*, 342 F.3d 1361, 1368 (Fed. Cir. 2003).

The claims themselves provide substantial guidance in determining the meaning of particular claim terms. *Phillips*, 415 F.3d at 1314. First, a term's context in the asserted claim can be very instructive. *Id.* Other asserted or unasserted claims can also aid in determining the claim's meaning because claim terms are typically used consistently throughout the patent. *Id.* Differences among the claim terms can also assist in understanding a term's meaning. *Id.* For example, when a dependent claim adds a limitation to an independent claim, it is presumed that the independent claim

does not include the limitation. *Id.* at 1314-15.

Claims "must be read in view of the specification, of which they are a part." *Id.* (quoting *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 978 (Fed. Cir. 1995)). "[T]he specification 'is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.'" *Id.* (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)); *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002). This is true because a patentee may define his own terms, give a claim term a different meaning than the term would otherwise possess, or disclaim or disavow the claim scope. *Phillips*, 415 F.3d at 1316. In these situations, the inventor's lexicography governs. *Id.* Also, the specification may resolve ambiguous claim terms "where the ordinary and accustomed meaning of the words used in the claims lack sufficient clarity to permit the scope of the claim to be ascertained from the words alone." *Teleflex, Inc.*, 299 F.3d at 1325. But, "although the specification may aid the court in interpreting the meaning of disputed claim language, particular embodiments and examples appearing in the specification will not generally be read into the claims." *Comark Communications, Inc. v. Harris Corp.*, 156 F.3d 1182, 1187 (Fed. Cir. 1998); *see also Phillips*, 415 F.3d at 1323. The prosecution history is another tool to supply the proper context for claim construction because a patent applicant may also define a term in prosecuting the patent. *Home Diagnostics, Inc., v. Lifescan, Inc.*, 381 F.3d 1352, 1356 (Fed. Cir. 2004) ("As in the case of the specification, a patent applicant may define a term in prosecuting a patent.").

Although extrinsic evidence can be useful, it is "less significant than the intrinsic record in determining 'the legally operative meaning of claim language.'" *Phillips*, 415 F.3d at 1317 (quoting *C.R. Bard, Inc.*, 388 F.3d at 862). Technical dictionaries and treatises may help a court understand

the underlying technology and the manner in which one skilled in the art might use claim terms, but technical dictionaries and treatises may provide definitions that are too broad or may not be indicative of how the term is used in the patent. *Id.* at 1318. Similarly, expert testimony may aid a court in understanding the underlying technology and determining the particular meaning of a term in the pertinent field, but an expert's conclusory, unsupported assertions as to a term's definition is entirely unhelpful to a court. *Id.* Generally, extrinsic evidence is "less reliable than the patent and its prosecution history in determining how to read claim terms." *Id.*

The Terms

The only claim being asserted in this case is Claim 1. The parties have agreed on the construction of several previously disputed terms, and the Court will construe the remaining disputed terms: "power turbine," "positioned between," "externally mounted intercooler," "return duct from said intercooler," "airflow to and from said intercooler in counterflow with coolant," "said outlet duct being configured to radially expand said air flow to a low velocity," "said return duct being configured for low radial flow return velocity to said high pressure compressor," and the term "the high pressure compressor having an inlet flow area directly proportional to the outlet flow area of the low pressure compressor, and inversely proportional to the absolute temperature ratio between the high temperature airflow discharged from the low pressure compressor compared to the low temperature air flow from the intercooler passing to the inlet area of the high pressure compressor." The complete text of the asserted Claim is provided herein, with each disputed term or phrase in underlined text:

> In a power producing system comprising a twin spool gas generator and a <u>power turbine</u>, said gas generator having a low pressure compressor driven by a low pressure turbine, a high pressure compressor driven by a high pressure turbine, a

> combustor positioned between said high pressure compressor and said high pressure turbine, said power turbine positioned downstream from said low pressure turbine, the improvement being characterized in that: said high and low pressure turbines being axially positioned and independently rotatable for driving said high and low pressure compressors respectively by means of concentric coaxial outer and inner shafting respectively said gas generator including at least one externally mounted intercooler positioned between said low pressure compressor and said high pressure compressor, at least one compressor outlet duct from said low pressure compressor communicating with said intercooler and at least one return duct from said intercooler communicating with said high pressure compressor, wherein said compressor outlet and return ducts and connections between said compressors and said intercooler are provided between said axially positioned low and high pressure compressors for air flow to and from said intercooler in counterflow with coolant, said outlet duct being configured to radially expand said air flow to a low velocity and said return duct being configured for low radial flow return velocity to said high pressure compressor, the high pressure compressor having an inlet flow area directly proportional to the outlet flow area of the low pressure compressor, and inversely proportional to the absolute temperature ratio between the high temperature airflow discharged from the low pressure compressor compared to the low temperature air flow from the intercooler passing to the inlet area of the high pressure compressor.

Power Turbine

Rice argues for a construction that includes an activity of driving a mechanical or electrical load. On the other hand, Rolls-Royce wants the requirement that the turbine is producing power to drive a fan or propeller. The specification distinguishes the power turbine as being a turbine that extracts energy from combusted gas to do work. *See* col. 6, lines 39-44. The additional characterizations proffered by both Rice and Rolls-Royce do not provide meaningful aid to the construction of the term. Therefore, the Court construes "power turbine" as "a turbine that extracts energy from combusted gas to do work."

Positioned between

The term "positioned between" is used twice in Claim 1. First, a combustor is recited as being "positioned between" the high pressure compressor and the high pressure turbine. Second,

the externally mounted intercooler is "positioned between" the low pressure compressor and the high pressure compressor. Rice proposes to construe the term as "in an intermediate position relative to." Rolls-Royce disputes this construction as improperly indicating a spatial relationship and proposes to construe the term as "positioned to receive the air flow directly from and to provide the air flow directly to." Rice replies that Rolls-Royce is misunderstanding its construction. Rice's only dispute with the construction proposed by Rolls-Royce is the "directly" limitation. Rice agrees that as to the intercooler, the construction proposed by Rolls-Royce correctly refers to "a position in the air flow path."

The only support offered by Rolls-Royce for inclusion of the limitation "directly" is a reference to Fig. 1 showing the intercoolers connected in the air flow path that extends from the low pressure compressor to the high pressure compressor. Apparently, Rolls-Royce's position is that "directly" signifies that there is nothing in addition to the intercooler in that air flow path other than ducting. The specification, however, does not indicate any requirement to exclude additional equipment from that air flow path. Moreover, the inventor's choice of the term "positioned between," rather than some more restrictive language to indicate that only the intercooler is in the air flow path, indicates that inclusion of the limitation "directly" in the construction is not appropriate.

The Court construes "positioned between" as to the combustor to mean "positioned to receive the air flow from the high pressure compressor and to provide the combustion gas to the high pressure turbine."

The Court construes "positioned between" as to the intercooler to mean "positioned to receive the air flow from the low pressure compressor and to provide the air flow to the high pressure

compressor.

"Externally mounted" Intercooler

The parties do not dispute that an intercooler is a heat exchanger.[2] The dispute is what it means that the intercooler is "externally mounted." Rice proposes that it simply means that the heat exchanger is mounted anywhere outside either the low pressure compressor or the high pressure compressor. Rolls-Royce proposes that the heat exchanger must be not only outside the compressor structures but also that it must be located away from them in a separately supported arrangement.

In support Rice argues for a plain meaning. In addition, Rice points to characterizations of the prior art made by an examiner during the prosecution of the '204 patent, which is not at issue in this litigation. Specifically, Rice notes that the examiner there characterized prior art structures as being for "external mounting." *See* Rice Br. at 16. The particular prior art was the '745 Price patent (U.S. 2,563,745). Def's Surreply Br. 1-3; Exh. 16. The intercoolers 23 in the '745 Price patent are located outside the engine housing 40. While the examiner's comments during the prosecution of the '204 patent are not controlling as to the construction of the claim language in the '499 patent, as Rice notes, it would be reasonable for a person of ordinary skill in the art to conclude that an "externally mounted" intercooler is one such as shown in the '745 Price patent. Rice Br. 16.

Indeed, the '499 specification shows in Figs. 2 and 3 depictions of an intercooled gas generator "of the present invention." Col. 5, lines 40-45. As shown in them, the flanges on the ducts 36 and 42, which are to be connected to the intercoolers 38 and 40 (not shown), establish a mounting location that is outside the casing 72. This indicates to one skilled in the art that the externally mounted intercooler is not only outside either compressor but is also outside the casing. However,

[2]Defendant's proposed construction adds "for cooling air flow between compressors" but the Court finds the additional language unnecessary that can be ascertained from the rest of the claim.

the proposal by Rolls-Royce that the intercooler be "located away" from the compressors does not capture with sufficient specificity the meaning that should be accorded the term.

The prosecution history, as an additional piece of intrinsic evidence, provides further insight into the meaning to be ascribed to the term "externally mounted intercooler." During the prosecution, claim 69 was rejected as being anticipated by Hull (U.S. Patent No. 3,273,340) in an Office Action dated April 11, 1989. The examiner specifically identified Hull as having an intercooler 16. In Hull, the intercooler 16 is shown inside the casing 11 of the engine, which encloses the compressors. Rice filed a response on July 7, 1989, amending claim 69 to include the further limitation that the recited intercooler was "externally mounted." Rice then remarked that "Hull uses annular ducting and intercooler and not separate piping to an externally mounted intercooler." Resp. 8. The scope of Rice's disclaimer during prosecution goes only to locating the intercooler outside the engine casing. Rice made no comment as to the mounting arrangement for the recited intercooler in contrast to the intercooler 16 of Hull.

Accordingly, the Court construes the term "externally mounted intercooler" to mean "a heat exchanger located outside the casing containing the low and high pressure compressors."

Return duct from said intercooler

Rice believes that this term need not be construed in that the ordinary and customary meaning of the term is clear. However, to the extent the Court finds construction necessary, Rice proposes that this term should be construed to read, "air duct through which air from the intercooler passes toward the high pressure compressor." While Rolls-Royce agrees the term need not be construed, Rolls-Royce asserts its construction, "conduit for conveying air back from the externally mounted intercooler (defined)." The specification notes that "[a]ir is compressed in a low-pressure

compressor 24 which is driven coaxially by turbine 28. Said air is diffused and then ducted to intercoolers 38 and 40 where said air is cooled before being *ducted back* to be further compressed by high-pressure compressor 44 driven by turbine 46." *See* col. 16, lines 11-16 (emphasis added). The specification is more precise that the air is not just passing through, but is being ducted back or returned.

Therefore, the Court construes "return duct from said intercooler" as "conduit for conveying air back from the externally mounted intercooler (defined)."

Airflow to and from said intercooler in counterflow with coolant

The parties do not dispute that "counterflow" means flowing in an opposite direction. The essence of the dispute is whether the frame of reference for determining the counterflow is outside the intercooler (Rice) or within the intercooler where there is heat transfer between the air flow and the coolant (i.e., thermal contact) (Rolls-Royce). Rice relies upon the recitation in the claim of air flow "to and from" the intercooler as indicating that it is the overall direction of the air flow between the compressors as established by the outlet and return ducts that is in counterflow with the coolant. That is, Rice focuses on the entry and exit points of each fluid. Rice Br. 22.

Rolls-Royce correctly points out that the plain meaning of the "to and from" recitation merely specifies that the intercooler positioning is such that air flow is to the intercooler from the low pressure compressor and from the intercooler to the high pressure compressor. Further, there is no dispute that one skilled in the art would consider heat exchange with a coolant to only take place inside an intercooler where there is thermal contact. To one skilled in the art, reference to "in counterflow with coolant" would only have meaning in regard to the flow of air through the intercooler and not air flow that is to and from it.

The specification supports a construction that the counterflow with coolant exists for air flow that is through the intercooler. In Fig. 1, the '499 patent provides a schematic diagram of the intercoolers 38, 40 as well as the outlet duct 36 from the low pressure compressor 24 and the return duct 42 to the high pressure compressor 44. As shown, the flow to the intercooler through duct 36 is in the same direction as the flow of the coolant out of the intercooler through line 70. Similarly, the flow out of the intercooler through duct 42 is in the same direction as the flow of the coolant into the intercooler through line 68. Only the flow within the intercooler is consistent throughout the schematic diagram with the plain meaning of "counterflow" as being in an opposite direction.

The prosecution history provides further guidance as to the manner in which the term "counterflow" is to be construed. In the response Rice filed on July 7, 1989, a further amendment to claim 69 was inclusion of the recitation "in counterflow with coolant." *See* Resp. 2. Rice then remarked that in the Hull patent disclosure "the heat exchanger 16 does not and cannot readily apply counterflow of the compressed air to the coolant." Rice further remarked that, "Therefore, a close approach temperature to the coolant at its entrance temperature is not possible because the partially compressed air and heated coolant flows in the same direction as the compressed air being cooled." Resp. 8.

In the disclosure of the Hull patent, air is divided into an outer stream and an inner stream. The outer stream of cooler air is applied to the input of a heat exchanger 16 as the coolant. The inner stream is compressed, which causes a temperature increase, and is input to the heat exchanger in parallel with the cooler outer stream. The airflow of both streams through the heat exchanger is shown to be in the same direction, as stated by Rice. The disclosure in Hull and Rice's remarks support a construction that counterflow with coolant means air flow through the intercooler is in an

opposite direction to the flow of coolant through the intercooler.

Rice contends that the prosecution history is consistent with its proposed definition in that it was the flows to and from the heat exchanger 16 in Hull, which are in the same direction, that were being distinguished. However, Rice's remarks when read closely identify reference is being made to the direction of "the compressed air being cooled." The compressed air is being cooled only inside the heat exchanger. Rice's comment, therefore, only has meaning in regard to flow inside the heat exchanger 16. Rice also contends that Rice's remarks should be taken in the context of other disclosures in Hull concerning alternative flow arrangements. However, the examiner's rejection specified heat exchanger 16 and Rice's remarks specified heat exchanger 16. Moreover, there is no specific description given in Hull of an alternative flow arrangement beyond a generalized statement that the streams could be passed through the heat exchanger twice wherein the bypass fluid flows in one set of passages and the compressed fluid flows through the other set of passages "in radial counterflow passes." This by no means clearly identifies the structure of such a heat exchanger. Moreover, the description is that "each" stream is directed through the heat exchanger twice in radial counterflow passes. This does not suggest that the compressed fluid is moving in the opposite direction to the bypass fluid.

Accordingly, the Court adopts the construction proposed by Rolls-Royce.

Said outlet duct being configured to radially expand said air flow to a low velocity and *said return duct being configured for low radial flow return velocity to said high pressure compressor*

Key to both phrases above is the term "low velocity." While a person or ordinary skill in the art arguably would understand that the air flow exiting the low pressure compressor is at a very high velocity, the parties disagree as to how the outlet and return ducts in the '499 Patent are designed to

slow the velocity. Thus, the Court will construe the term "low velocity" first.

Low velocity

Claim 1 specifies that the outlet duct of the low pressure compressor is configured to radially expand air flow "to a low velocity" and the return duct is configured for "low radial flow return velocity." Rice contends that the term "low velocity" should be construed to mean "a decreased air flow velocity." Rolls-Royce, on the other hand, wants a specific numerical value and contends that the low velocity term means air flow velocity "less than approximately 200 ft./sec."

Notably, the claim language is not "to a low<u>er</u> velocity" or "to a reduced velocity." Rice, however, points out that dependant claim 9 includes the specific numerical limitation of less than approximately 200 ft./sec. Rolls-Royce counters that claim 9 specifies "<u>said</u> low velocity of less than approximately 200 ft./sec." which indicates that the prior use of low velocity was meant as "less than approximately 200 ft./sec." Rolls-Royce further identifies in the specification where Rice described the preferred embodiment as having air flow velocity of about 200 ft./sec. *See* Def's Br. 33-35.

However, there is no indication in the descriptive passages cited by Rolls-Royce that a velocity less than approximately 200 ft./sec. is critical to the invention. While the reduction in velocity is identified as being advantageous to "reduce inlet pressure loss" (col. 8, line 27), nowhere does the specification indicate that the velocity of 200 ft./sec. is in and of itself a necessary parameter to be met in order to realize the gas generator of the invention. Rather, the specification indicates that the low pressure loss benefit resulting from a lower air flow velocity between the low and high pressure compressors is made possible by the additional radial space made available by the increased pitch-line radius, r, as a consequence of the intercooler. *See* col. 8, lines 28-38. The description in the '499 patent specification of the air flow velocity is unlike the situation identified in *Toro Co. v.*

White Consolidated Industries, Inc., 199 F.3d 1295 (Fed. Cir. 1999), wherein the specification described the advantages of a unitary structure of a ring permanently attached to a cover as being important to the invention.

Rolls-Royce also relies upon the prosecution history for support of its proposed construction of "low velocity." Specifically, Rolls-Royce identifies that the July 7, 1989 Amendment added the "low velocity" recitation to the claims and argues that Rice's remarks indicate that a low velocity of less than 200 ft./sec. was needed. Examination of Rice's remarks indicate that Hull was being distinguished on the basis of an absence of an external counterflow intercooler. Rice first points out that the compressed air being cooled in Hull's heat exchanger 16 and the coolant flow in the same direction. Rice then offered that Hull did not have a low pressure drop heat exchanger and ducting, which are realized by the claimed counterflow externally mounted intercooler. Amendment 8.

When Rice turned to the DuPont prior art, Rice again argued that a counterflow externally mounted intercooler was absent just as in Hull. Rice also pointed out that the discharge of the axial flow fan 18 of DuPont was directly to heat exchanger 26 and would be high. Similarly, the velocity to downstream heat exchanger 28 would be high "because there is very little change in the cross-sectional flow area shown." Amendment 9. Rice's remarks indicate nothing more than the prior art did not include the ducting that would radially expand the air flow to a lower velocity. His remarks do not indicate that either Hull or DuPont were being distinguished on the basis of the specific air flow velocity through the heat exchanger and ducting of each. The import of Rice's remarks do not extend beyond the requirement that the ducting radially expand the air flow to slow it to a lesser velocity. The remarks clearly do not amount to a clear disclaimer of air flow velocities through the intercooler and associated ducting above 200 ft./sec. Thus, the Court adopts Rice's construction for

"low velocity" as being "a decreased air flow velocity."

Having adopted Rice's construction of low velocity, the Court turns to the disputed term *"to radially expand."* Rice proposes the construction "to cause air flowing away from the axis of the shafting to increase in volume." Rice argues that a person of ordinary skill in the art would understand that "radially expand" means something expands as it moves away from the axis, in contrast to "axial" which indicates a direction along the axis. Rolls-Royce, on the other hand, proposes the construction "to increase the cross-sectional flow area in a direction generally perpendicular to the axis of the gas generator."

However, the embodiment disclosed in figure 7a of the '499 patent depicts a duct that "radially expands" the air flow from the low pressure compressor. The air flowing radially through the duct in figure 7a is not perpendicular to the axis of the gas generator. Further, the specification describes how the direction of the flow with respect to the radial position can be "curved backwards" and vary in angle to accommodate the different structures. Col. 14, lines 44-50. Nothing requires that the expansion occur only when the air is flowing perpendicular to the axis. Thus, the Court adopts Rice's plain meaning "to cause air flowing away from the axis of the shafting to increase in volume."

The parties previously requested no construction for the term "outlet duct;" therefore, the Court will not construe that term. The Court previously construed "return duct" to mean "conduit for conveying air back from the externally mounted intercooler."

In sum, the Court construes the disputed term, "said outlet duct being configured to radially expand said air flow to a low velocity" to mean "said outlet duct shaped and positioned to cause air flowing away from the axis of the shafting to increase in volume resulting in a decreased air flow

velocity."

The Court construes the disputed term, "said return duct being configured for low radial flow return velocity to said high pressure compressor" to mean "the conduit conveying air back from the externally mounted intercooler being shaped and positioned to result in a velocity of air flowing toward the axis of the shafting that is lower than the velocity of that air when it enters the high pressure compressor."

"The high pressure compressor having an inlet flow area directly proportional to the outlet flow area of the low pressure compressor, and inversely proportional to the absolute temperature ratio between the high temperature air flow discharged from the low pressure compressor compared to the low temperature air flow from the intercooler passing to the inlet area of the high pressure compressor"

To the extent the parties seek construction term-by-term, the Court finds that approach to be confusing and unnecessary and declines to do so. Rather, the claim language in dispute clearly expresses a relationship between two specified structures: the inlet flow area of the high pressure compressor (AHPC) and the outlet flow area of the low pressure compressor (ALPC). As depicted in the specification in Fig. 2, the pitch line radius "r" establishes the flow area of the low pressure compressor 24 outlet (ALPC). The pitch line radius "r3" establishes, as shown in Fig. 4, the flow area of the high pressure compressor 44 inlet (AHPC). *See* col. 8, lines 51-53. The specified relationship is expressed in terms of a direct proportioning of the flow areas. Thus, a direct proportioning exists of the pitch line radii, r and r3, [i.e., as the outlet flow area of the low pressure compressor gets larger (r gets bigger), the inlet flow area of the high pressure compressor gets correspondingly larger (r3 gets bigger) in accordance with some constant ratio].

However, because of the intercooler, the proportioning constant between (AHPC) and (ALPC) also includes an additional proportioning factor established by the ratio of the absolute temperature

of the high temperature air flow discharged from the low pressure compressor (T_{LPC}) and the low temperature air flow from the intercooler passing to the inlet area of the high pressure compressor (T_{HPC}). This temperature ratio is expressed as (T_{LPC}/T_{HPC}). However, the relationship of the inlet flow area of the high pressure compressor (A_{HPC}) and the outlet flow area of the low pressure compressor (A_{LPC}) changes in inverse proportion to the temperature ratio (T_{LPC}/T_{HPC}). That is, as the ratio of (T_{LPC}/T_{HPC}) gets larger, the inlet flow area of the high pressure compressor (A_{HPC}) gets smaller.

The claim limitation can be expressed mathematically as:

$$A_{HPC} \propto A_{LPC} / (T_{LPC}/T_{HPC}) \text{ or } A_{LPC}/A_{HPC} \propto (T_{LPC}/T_{HPC})$$

Thus, as the intercooler provides more cooling of the air flow from the outlet of the low pressure compressor, which is at a temperature T_{LPC}, the temperature of the air flow from the intercooler passing to the inlet area of the high pressure compressor (T_{HPC}) is further reduced relative to temperature air flow discharged from the low pressure compressor (T_{LPC}). Accordingly, the denominator of the ratio gets smaller and the ratio gets correspondingly larger. The consequence is that, because the inlet flow area of the high pressure compressor (A_{HPC}) changes in inverse proportion to this ratio, the inlet flow area of the high pressure compressor (A_{HPC}) gets smaller.

This claim language was added during the reexamination prosecution of the '499 patent. In his statement to the examiner, Rice identified support in the specification to be found at column 9, beginning with line 1. As to the patentability of the amended claim, Rice characterized the limitation as expressing a power producing system wherein "the inlet flow area to the high pressure compressor is matched to the conditions of the air flow exiting the low pressure compressor," which was said to be "governed by Boyle's Law." Statement 4. Rice also notes that other factors could be changed

to satisfy Boyle's Law, such as changing the speed of the compressor could be used, although "a change in speed is not used to obtain the desired substantial matching to satisfy Boyle's Law." Statement 5. Rice was specific that "matching of the low and high pressure compressors is uniquely obtained by satisfying the area and temperature relationships recited in the amended claims." *Id.* Indeed, the disclosure in column 9 cited in support of the claim amendment describes the matching of the flow areas according to Boyle's Law based upon the low and high pressure compressors running at a constant RPM.

The disclosure explains that, because the air from the low pressure compressor is cooled before being admitted to the inlet of the high pressure compressor, the density of the cooled air is increased accordingly to Boyle's Law. Because of the constant RPM, there is the necessity to size the pitch line radii of the compressors according to the change in density. In the illustrated embodiment, the pitch line radius r3 of the high pressure compressor remains constant and the pitch line radius r of the low pressure compressor is sized (i.e., matched to the inlet of the high pressure compressor) based on the relationship of $A_{HPC} \propto A_{LPC} / (T_{LPC}/T_{HPC})$ and the specified operating conditions of the intercooler.

The parties dispute whether satisfaction of the relationship of $A_{HPC} \propto A_{LPC} / (T_{LPC}/T_{HPC})$ is to be evaluated while the system is producing power (Rice) or whether it is evaluated as a design rule (RR). Claim 1 is clearly directed to apparatus and not a method. Thus, the focus is on the structure of the power producing system and not on any sequence of steps conducted by a system in producing power or attaining a particular operating condition. More specifically, the claim limitation concerns defining the relationship of the structures of the low and high pressure compressors as to the size of the outlet and inlet flow areas, respectively. The structure is thereby established and does

not change during operation of the system while producing power.

Rice argues that the subject claim limitation embraces a dynamic operating environment because the specification presents a thermodynamic analysis of the invention. *See* Pl.'s Br. 39. However, the thermodynamic analysis "of this invention" and for "optimum efficiency" presented in column 16, line 1, through column 23, line 3, is premised on the intercooler being sized to effect a specified exit temperature under specified environmental conditions for a particular approach temperature. *See* col. 16, lines 54-57. This supports Rolls-Royce's argument that the relationship of $A_{HPC} \propto A_{LPC} / (T_{LPC}/T_{HPC})$ is a design rule applied to obtain low and high pressure compressor structures optimized for a predetermined operating condition of the intercooler.

The Court construes the claim limitation to mean "a design rule applied to optimize the cross-sectional area of the air flow inlet of the high pressure compressor in relation to the cross-sectional area of the air flow outlet of the low pressure compressor for a predetermined operating condition of the intercooler (1) by having the areas increase or decrease together on a constant ratio basis between them and (2) by having the cross-sectional area of the air flow inlet of the high pressure compressor also increase or decrease in opposite to the ratio of the absolute temperature of the air flow at the cross-sectional area of the air flow outlet of the low pressure divided by the absolute temperature of the air flow at the cross-sectional area of the air flow inlet of the high pressure compressor (i.e., the area increases as the ratio gets smaller and decreases as the ratio gets larger), which can be expressed mathematically as: $A_{HPC} \propto A_{LPC} / (T_{LPC}/T_{HPC})$."

Conclusion

For the foregoing reasons, the Court interprets the claim language in this case in the manner set forth above. For ease of reference, the Court's claim interpretations are set forth in a table

attached to this opinion.

So ORDERED and SIGNED this 21st day of November, 2006.

JOHN D. LOVE
UNITED STATES MAGISTRATE JUDGE

Claim Construction Chart
U.S. Patent No. 4,896,499 & U.S. Patent No. 4,896,499 B1

Claim Language	Claim Term	Plaintiff's Proposed Construction	Defendant's Proposed Construction	Court's Construction
In a **power producing system** comprising a twin spool gas generator and a **power turbine**	power producing system	AGREED	AGREED	system for producing power
	power turbine	turbine that drives a mechanical or electrical load	turbine for producing power (The claim term "power turbine" includes but is not limited to a turbine for producing power to drive a fan or propeller)	A turbine that extracts energy from combusted gas to do work.
said gas generator having a **low pressure compressor** driven by a **low pressure turbine**,	low pressure compressor	AGREED	AGREED	the compressor that operates at a lower pressure relative to the other compressor
	low pressure turbine	AGREED	AGREED	the turbine that drives the low pressure compressor
a **high pressure compressor** driven by a **high pressure turbine**,	high pressure compressor	AGREED	AGREED	the compressor that operates at a higher pressure relative to the other compressor
	high pressure turbine	AGREED	AGREED	the turbine that drives the high pressure compressor
a combuster **positioned between** said high pressure compressor and said high pressure turbine,	positioned between	in an intermediate position relative to	positioned to receive air flow directly from and to provide air flow directly to [two other things, respectively]	positioned to receive the air flow from the high pressure compressor and to provide the combustion gas to the high pressure turbine
said power turbine **positioned downstream from** said low pressure turbine,	positioned downstream from	AGREED	AGREED	positioned to receive the air flow from (directly or indirectly)

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said gas generator including at least one **externally mounted intercooler positioned between** said low pressure compressor and said high pressure compressor,	externally mounted intercooler	heat exchanger mounted on any structure outside either compressor	heat exchanger for cooling air flow between compressors supported separately and located away from the low and high pressure compressors, i.e., off of, and removed from, the low and high pressure compressors (This claim term excludes an annular intercooler mounted radially relative to the axis of the gas generator)	heat exchanger located outside the casing containing the low and high pressure compressors
	positioned between			positioned to receive the air flow from the low pressure compressor and to provide the air flow to the high pressure compressor
or at least one **compressor outlet duct from said low pressure compressor** communicating with said intercooler, and	outlet duct	NO CONSTRUCTION REQUESTED	NO CONSTRUCTION REQUESTED	
	compressor outlet duct from said low pressure compressor	NO CONSTRUCTION REQUESTED	NO CONSTRUCTION REQUESTED	
at least one **return duct from said intercooler** communicating with said high pressure compressor,	return direct from said intercooler	air conduit through which air from the intercooler passes toward the high pressure compressor	conduit for conveying air back from the externally mounted intercooler (defined)	conduit for conveying air back from the externally mounted intercooler

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wherein said compressor outlet and return ducts and connection between said compressors and said intercooler are provided between said axially positioned low and high pressure compressors for **air flow to and from said intercooler in counterflow with coolant,**	air flow to and from said intercooler in counterflow with coolant	airflow to and from the intercooler flowing in an opposite direction with coolant	the air flow and the coolant through the intercooler (defined) flowing in thermal contact and in opposite direction so that the temperature of the air flow closely approaches the temperature of the coolant at its inlet to the intercooler (defined)	the air flow and the coolant through the intercooler flowing in thermal contact and in opposite direction through a heat exchanger so that the temperature of the air flow closely approaches the temperature of the coolant at its inlet to the intercooler
said **outlet duct** being **configured to radially expand said air flow to a low velocity** and	outlet duct	outlet duct	the conduit for conveying air from the outlet of the low pressure compressor	outlet duct
	configured	AGREED	AGREED	shaped and positioned
	to radially expand said air flow to a low velocity	to cause air flowing away from the axis of the shafting to increase in volume resulting in a decreased air flow velocity	to increase the cross-sectional flow area in a direction generally perpendicular to the axis of the gas generator resulting in an air flow velocity of less than approximately 200 ft/sec	to cause air flowing from the axis of the shafting to increase in volume resulting in a decreased air flow velocity

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said return duct being configured for low radial flow return velocity to said high pressure compressor	said return duct	the return duct	the conduit conveying air back from the externally mounted intercooler (defined) to the high pressure compressor	conduit for conveying air back from the externally mounted intercooler
	being configured	being shaped and positioned	being shaped and positioned	being shaped and positioned
	for low radial flow return velocity to said high pressure compressor	to result in a velocity of air flowing toward the axis of the shafting that is lower than the velocity of that air when it enters the high pressure compressor	for less than approximately 200 ft/sec air flow velocity in a direction generally perpendicular to the axis of the gas generator	to result in a velocity of air flowing toward the axis of the shafting that is lower than the velocity of that air when it enters the high pressure compressor
the high pressure compressor having an **inlet flow area directly proportional** to the **outlet flow area** of the low pressure compressor, and **inversely proportional** to the **absolute temperature ratio** between the **high temperature airflow discharged from the low pressure compressor compared to the low temperature air flow from the intercooler passing to the inlet area of the high pressure compressor.**	inlet flow area	AGREED	AGREED	cross-sectional area of the air flow inlet
	outlet flow area	AGREED	AGREED	cross-sectional area of the air flow outlet
	inlet area	AGREED	AGREED	cross-sectional area of the air flow inlet
	directly proportional	in direct proportion to, describing two values that are directly related to one another, where such direct relationship can be expressed mathematically	having a constant ratio in relation to	NO CONSTRUCTION NECESSARY

Claim Language	Claim Term	Plaintiff's Proposed Construction	Defendant's Proposed Construction	Court's Consideration
	inversely proportional	in inverse proportion to, describing two values that are inversely related to one another, where such inverse relationship can be expressed mathematically	having a constant ration in relation to the reciprocal of	NO CONSTRUCTION NECESSARY
	compared to	AGREED	AGREED	divided by
	absolute temperature ratio	the ratio of the absolute temperature of the high temperature air flow (defined) to the absolute temperature of the low temperature air flow (defined), while this system is producing power	ratio of the absolute temperature of the high temperature air flow (defined) to the absolute temperature of the low temperature air flow (defined), at the design port	NO CONSTRUCTION NECESSARY
	high temperature airflow	airflow that is being discharged from the low pressure compressor, while the system is producing power	the air flow at the outlet flow area (defined) of the low pressure compressor, at the design point	NO CONSTRUCTION NECESSARY
	high temperature airflow discharged from the low pressure compressor	airflow that is being discharged from the low pressure compressor, while the system is producing power	the air flow at the outlet flow area (defined) of the low pressure compressor, at the design point	NO CONSTRUCTION NECESSARY

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	low temperature airflow	airflow that is being discharged from the intercooler, toward the inlet area of the high pressure compressor, while the system is producing power	the air flow at the inlet flow area (defined) of the high pressure compressor, at the design point	NO CONSTRUCTION NECESSARY
	low temperature airflow from the intercooler passing to the inlet area of the high pressure compressor	airflow that is being discharged from the intercooler, toward the inlet area of the high pressure compressor, while the system is producing power	the air flow at the inlet flow area (defined) of the high pressure compressor, at the design point	NO CONSTRUCTION NECESSARY

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the high pressure compressor having an inlet flow area directly proportional to the outlet flow area of the low pressure compressor, and inversely proportional to the absolute temperature ratio between the high temperature airflow discharged from the low pressure compressor compared to the low temperature air flow from the intercooler passing to the inlet area of the high pressure compressor	high pressure compressor having an inlet flow area directly proportional to the outlet flow area of the low pressure compressor, and inversely proportional to the absolute temperature ratio between the high temperature airflow discharged from the low pressure compressor compared to the low temperature air flow from the intercooler passing to the inlet area of the high pressure compressor	the high pressure compressor having an 'inlet flow area' (defined) that is both 'directly proportional' (defined) to the 'outlet flow area of the low pressure compressor' (defined) and 'inversely proportional' (defined) to the 'absolute temperature ratio' (defined), and that satisfies the following mathematical relationship: $A_{HPC} = A_{LPC}/(T_{LPC}/T_{HPC})$	the inlet flow area (defined) of the high pressure compressor ("A_{HPC}") having a constant ratio in relation to the outlet flow area (defined) of the low pressure compressor ("A_{LPC}"), and to the reciprocal of the absolute temperature ratio (defined) ("T_{LPC}/T_{HPC}"), which may be expressed mathematically as: $A_{HPC} \propto A_{LPC}/(T_{LPC}/T_{HPC})$, or $A_{LPC}/A_{HPC} \propto T_{LPC}/T_{HPC}$ The claimed proportional relationship is a design rule by which the low and high pressure compressors of a twin spool gas generator that lacks an intercooler are to be re-sized and re-matched at the design point to accommodate the addition of an intercooler. In a twin spool gas generator lacking an intercooler, the air leaving the low pressure compressor enters the high pressure compressor without change in absolute temperature. As disclosed in	a design rule applied to optimize the cross-sectional area of the air flow inlet of the high pressure compressor in relation to the cross-sectional area of the air flow outlet of the low pressure compressor for a predetermined operating condition of the intercooler (1) by having the areas increase or decrease together on a constant ratio basis between them and (2) by having the cross-sectional area of the air flow inlet of the high pressure compressor also increase or decrease in opposite to the ratio of the absolute temperature of the air flow at the cross-sectional area of the air flow inlet of the high pressure compressor (i.e., the area increases as the ratio gets smaller and decreases as the ratio gets larger), which can be expressed mathematically as: A_{HPC} $A_{LPC}/(T_{LPC}/T_{HPC})$.

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			the specification and explained in the prosecution history, the addition of an intercooler between the low and high pressure compressors causes a decrease in the absolute temperature of the air from the low pressure compressor that enters the high pressure compressor. The claimed design rule is that the area ration A_{LPC}/A_{HPC} must be increased in proportion to the increase in the absolute temperature ratio T_{LPC}/T_{HPC} resulting from the addition of the intercooler. As disclosed in the specification, for example, if the absolute temperature ratio increases by the factor 1.41 (41 percent) due to the addition of an intercooler, then, in accordance with the invention, the area ratio A_{LPC}/A_{HPC} must also be increased by the factor 1.41 (41 percent). (499 Patent, Col. 9, lines 16-21).	

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			Based on disclaimers made by Plaintiff during reexamination of the 499 Patent, the claimed proportional relationship excludes modifying the speed of the low and/or high pressure compressors, and/or the velocity of the air flow, to accommodate the addition of an intercooler. Furthermore, the claimed proportional relationship does <u>not</u> mean that the area ratio A_{LPC}/A_{HPC} is proportional to the absolute temperature ratio T_{LPC}/T_{HPC} during system operation. This is clear from the fact that area ratio A_{LPC}/A_{HPC} is a fixed number, as disclosed in the specification, so the area ratio cannot possibly change during system operation in proportion to the temperature ratio T_{LPC}/T_{HPC}, which does change.	

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			Nor does the claimed proportional relationship mean that $A_{LPC}/A_{HPC} = T_{LPC}/T_{HPC}$ at any specific operating point, as Plaintiff contends. The claim recites a proportional relationship, not an equation that defines a specific operating condition. Moreover, neither the specification nor the prosecution history of the 499 Patent supports Plaintiff's construction.	